Project Catalyst Trial Report

Variable Rate Gypsum on a Sodic Block.

Grower Information	
Grower Name:	Walter Giordani
Entity Name:	W & N Giordani
Trial Farm No/Name:	Variable rate soil amendments (gypsum) within a sodic soil block. Farm # 796A
Mill Area:	Victoria
Total Farm Area ha:	178
No. Years Farming:	15 years
Trial Subdistrict:	Helens Hills/Yuruga
Area under Cane ha:	175.53

Photo below: Walter Giordani's variable rate spreader.

Background Information

Aim: To assess the opportunity to use variable rate technology to apply soil amendments (like gypsum) to target sodic zones within the block and the opportunity to implement such systems on a cane farm in the Herbert cane region.

Background: (Rationale for why this might work)

The soils which Walter (the grower) farms are highly variable and there are areas within blocks that are sodic. Sodic soils are found throughout the Australian sugarcane industry and are generally found outside the Wet Tropics in lower rainfall areas where sodium salts cannot be flushed out of the soil through leaching events associated with high rainfall and soil permeability.

Sodic soils form within a landscape where high concentrations of sodium salts have leach over time, leaving a high proportion of sodium attached to the clay colloids. High concentrations of sodium attached to clay particles, in the absence of high concentrations of soluble salts are not directly toxic to the cane plant. However, deterioration of soil structure and subsequent effects on plant growth and subsequent yield do occur. (Webster and Wilcox 1999). These sodic areas limit crop growth and effective utilisation of applied nutrients both macro and micronutrients.

(Nelson and Ham, 1998) found that excessive sodium in the soil reduces cane yield. In the Burdekin, for every 1% increase in sub-soil ESP (25-50 cm) there was a 2.4 t/ha reduction in yield Similarly, in the Central region there was a 1.5 t/ha reduction in cane yield for every 1% increase in sub-soil ESP.

Previous research undertaken by numerous parties identified that the use of soil amendments (gypsum, lime and mill by-products) would remediate these soils and improve crop growth and yields.
The main goal in managing sodic soils is to reduce the degree of sodicity. To achieve this a calcium source (either gypsum, lime, and mill by-products) should be added and leached into the soil. As the soil amendment leaches through the soil profile the calcium replaces the sodium on the clay colloids (Webster and Wilcox 1999).

Typically, sodic soils in the Herbert have been managed through the application of the soil amendments across the whole field, this practice has over applied the soil amendment in some parts of the field and under applied in other parts of the field. This project has used EM data collected through the use of a Dual EM device to map soil variability; these maps are then used to target soil tests for chemical analysis. Once soil tests results are received a variable rate prescription map is generated for the field and then applications of soil amendments are then applied to the field based upon the variable application map. In trial 2 the use of other spatial data was utilised and assessed to investigate opportunities to use other geospatial data available.

The purpose of this project to investigate the following:

1. If there is a financial benefit to applying soil amendments variable across a field.
2. If targeting high and low sodic soil areas with differing soil amendment rates will lead to improvements in sugarcane yield and ratoonability.

Potential Water Quality Benefit:

Markley and Hughes (2019) reported that nutrient (especially nitrogen) uptake would be impacted by sodic soils. By addressing sodicity soil issues within the block it is expected that there will be an improvement in plant uptake of nutrients and improvements in NUE, which would lead to a reduction in nutrient runoff from the block into the waterways.

Expected Outcome of Trial:

1. Improved cane yields.
2. Targeted management of sodic soils within a field.
3. Improved soil structure.
4. Improved NUE and reduce potential for nutrient losses from a field.
5. Wider adoption of the practice across the farm and across the district.

Service provider contact: Megan Zahmel 0447 317 102

Where did this idea come from: Walter Giordani (the grower)

Photo above- Variable rate gypsum being applied in trial 2.

Plan - Project Activities	Date: (mth/year to be undertaken)	Activities :(breakdown of each activity for each stage)
Stage 1	**Establish trial 2018**	10/1/2018 – Baseline soils samples taken from the block by Walter. May 2018 – The first trial block was EM mapped. 22/05/2018- Soil samples taken in the poor zones of the block and the good zones of the block to compare each area chemically. 25/25/2018 – Trial treatments applied to the block. 31/05/2018 – Trial planted to the variety- SRA3.
Stage 2	**Sampling and observations 2018**	5/7/2018 – Germination shoot counts 14/8/2018 – Shoot counts 22/10/2018 – Shoot counts
Stage 3	**Sampling and observations 2019**	The final yield and CCS of trial 1 could not be captured because the grower decided to conduct a "harvester fuel improvement trial" with the site. HCPSL staff captured drone footage of the site prior to harvest. The drone footage clearly highlighted cane yield differences between the industry common practice and the variable rate practice.
Stage 4	**Observations and data collection 2020**	Due to the impact of drought, sugarcane smut infestation and poor ratooning of trial 1, it was decided to plough the block out in 2020. Trial 2 was established in 2020. 30/7/2020-This site was EM mapped. 31/08/2020- Trial treatments applied to the block. Late 2020- The block was planted to a cowpea cover crop. Trial 2 was established to utilise additional spatial data like NDVI imaginary past and during the fallow crop phase to support EM data to site specific site management.
Stage 5	**Observations and data collection 2021**	Trial 2 was be planted to a cowpea (Ebony) cover crop during the 2020/2021 fallow period, with cane being planted into the block in 2021. NDVI imagery and drone footage of the block will be captured when weather conditions allow. Results will be provided in this report or subsequent reports.

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Project trial site 1 details:

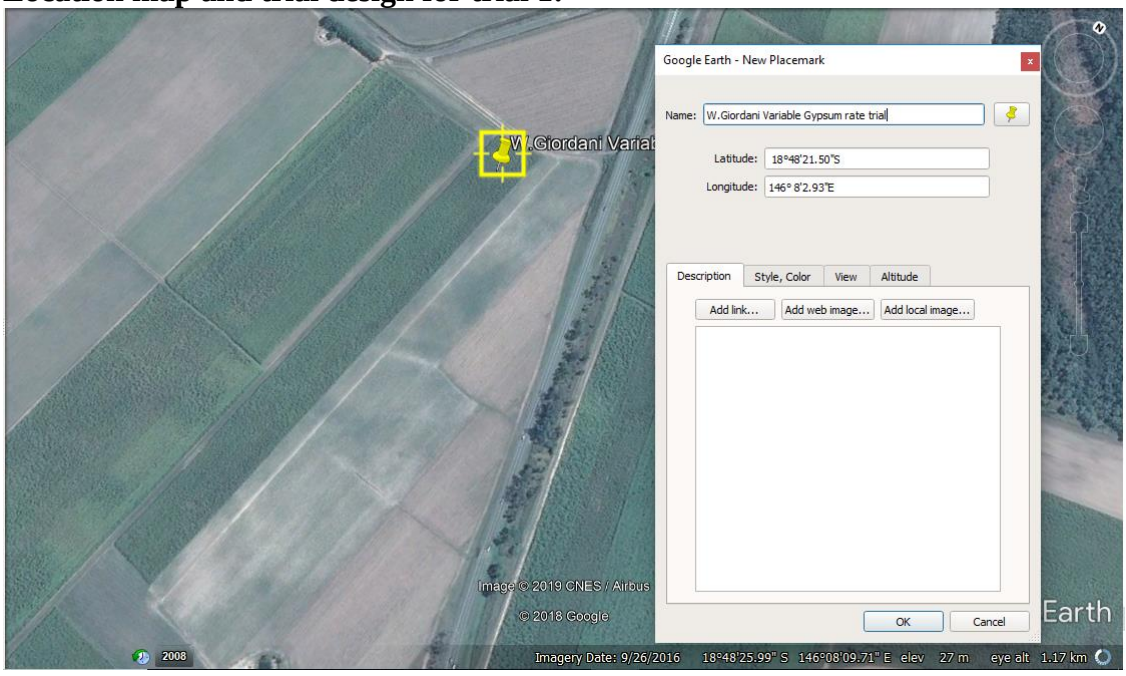
Trial Crop:	Sugarcane
Variety: **Rat/Plt:**	SRA 3 Plant 2018
Trial Block No/Name:	Farm# 796A Block # 6-5 Variable Gypsum trial
Trial Block Size Ha:	5.18ha
Trial Block Position (GPS):	Refer to google earth map
Soil Type:	Sandy Clay

Block History, Trial Design:

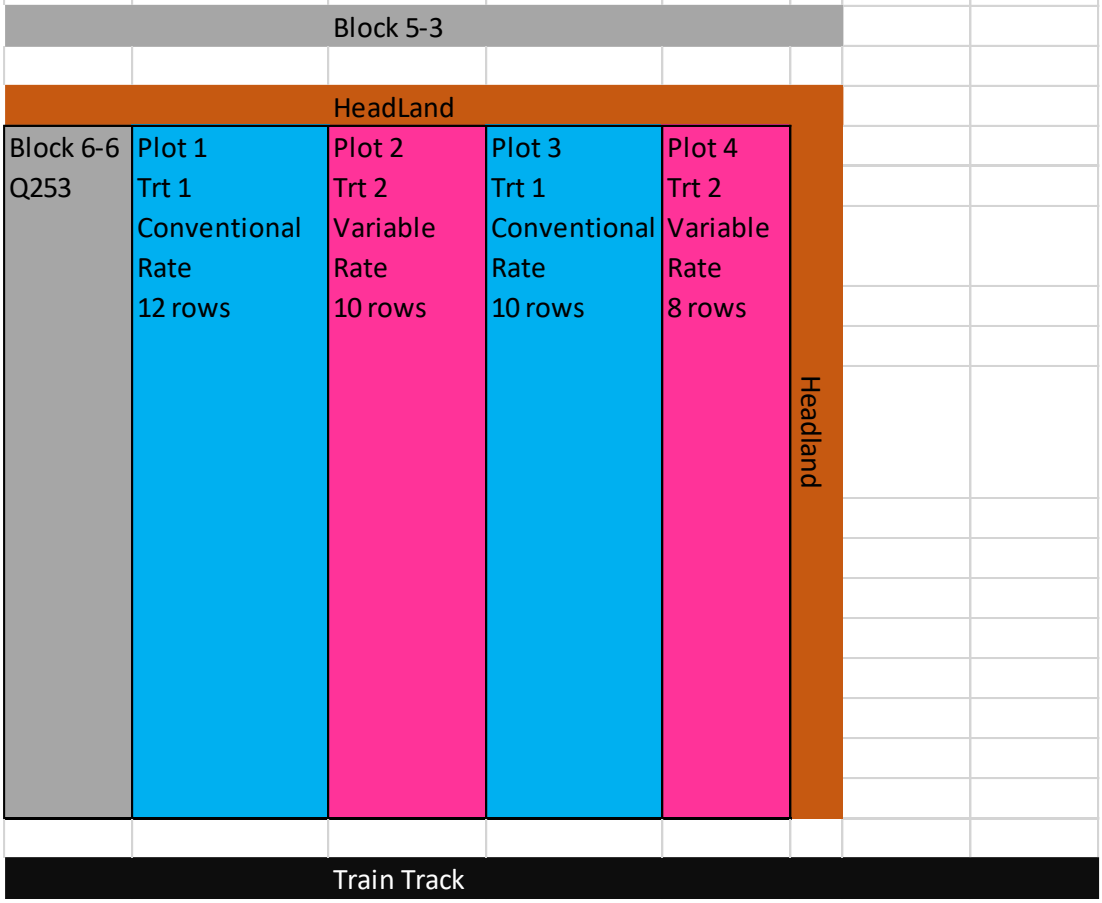
Block History:

- Wal Giordani bought the farm in 2012.
- Zonal mud & ash since 2012.
- Variable rate amendment since 2012.
- Change row spacing to 1.8m in 2017.

Location map and trial design for trial 1:

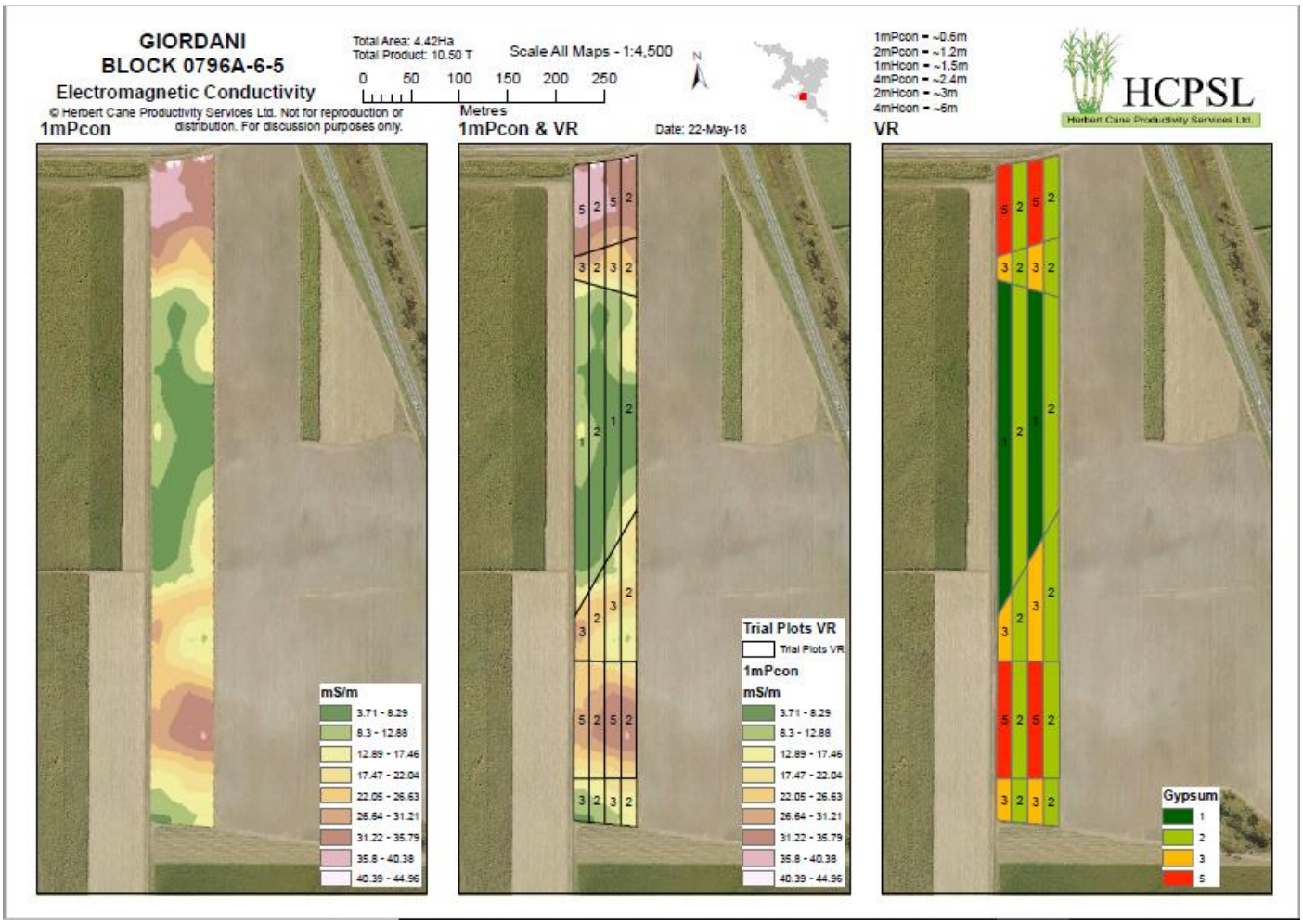


Walter Giordani
Variable Rate Gypsum trial
25/05/2018 established
Farm # 796
Block# 6-5



Treatments:
Treatment 1 – Conventional rate of 2 tonnes per hectare of Gypsum
Treatment 2 – Variable rates of 5 tonnes, 3 tonnes, 1 tonne per hectare of Gypsum

Below- Variable prescription map and EC map- trial 1.



Project trial site 2 details:

Trial Crop:	Sugarcane/ Legume cover crop
Variety: **Rat/Plt:**	Previously Q208 Fallow planted to a cowpea (Ebony) cover crop.
Trial Block No/Name:	Farm # 796: block 7-3 (0.23ha) and block 7-4 (3.32ha) Variable Gypsum trial
Trial Block Size Ha:	3.55ha
Trial Block Position (GPS):	Refer to google earth map
Soil Type:	Sandy Clay

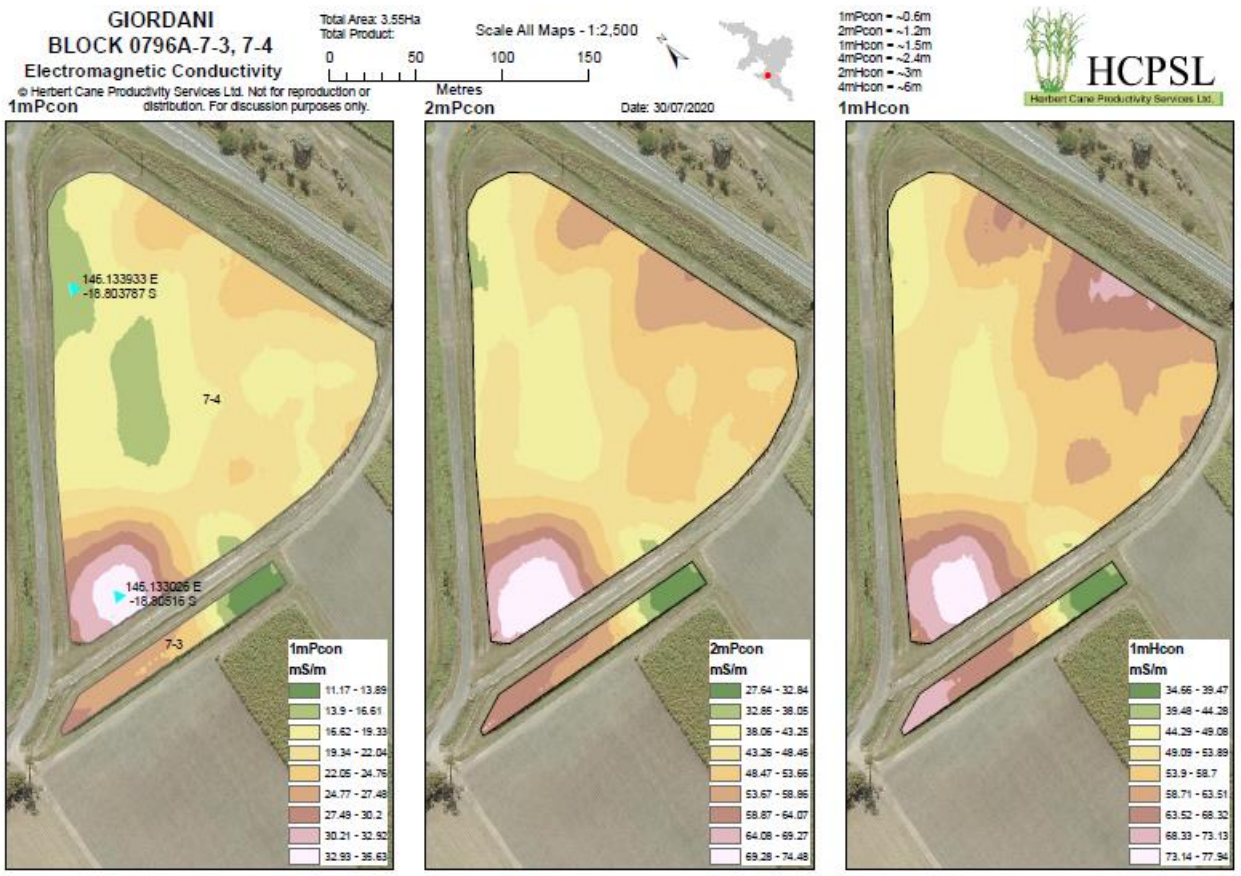
Block History, Trial Design:

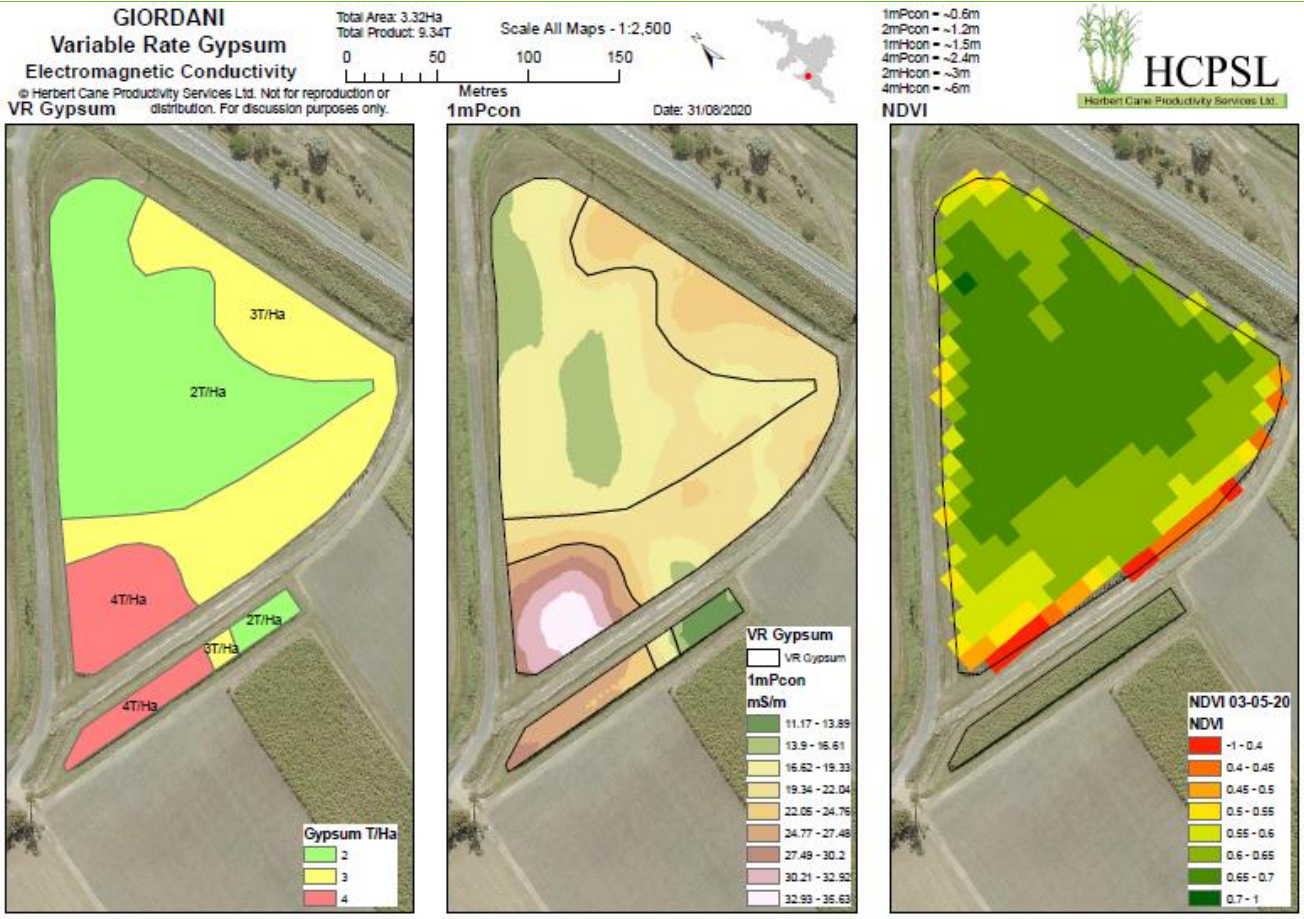
Block History:

- Wal Giordani bought the farm in 2012.
- Zonal mud & ash since 2012.
- Variable rate amendment since 2012.
- Change row spacing to 1.8m in 2017.

Location map for trial 2:

Below- EM maps with data collected at varying depths for trial 2:





Above left- variable rate map for trial 2.
Above centre- zonal map for trial 2 generated from the EM map and NDVI map.
Above right- NDVI map for May 2019 for the block while it was in cane for trial 2.

Both EM and NDVI (previous) crop data for trial 2 was used to generate the variable rate map for the site.

Results:

Trial 1 results:

Shoot count data-

Shoots counts were undertaken during cane establishment for trial 1. Significantly more shoots were observed in the variable rate treatments.

Average Shoot counts for July, August and October 2018 to compare between conventional rates and variable rates

5th July 2018			
Conventional rate		Variabe rate	
Average shoot count for **Area 3 - 2t/ha**	57	Average shoot count for **Area 3 - 5t/ha**	75
Average shoot count for **Area 2 - 2t/ha**	107	Average shoot count for **Area 2 - 1t/ha**	138
Average shoot count for **Area 1 - 2t/ha**	95	Average shoot count for **Area 1 - 5t/ha**	82

14th of August 2018			
Conventional rate		Variabe rate	
Average shoot count for **Area 3 - 2t/ha**	109	Average shoot count for **Area 3 - 5t/ha**	167
Average shoot count for **Area 2 - 2t/ha**	285	Average shoot count for **Area 2 - 1t/ha**	379
Average shoot count for **Area 1 - 2t/ha**	299	Average shoot count for **Area 1 - 5t/ha**	266

22nd of October 2018			
Conventional rate		Variable rate	
Average shoot count for **Area 3 - 2t/ha**	339	Average shoot count for **Area 3 - 5t/ha**	391
Average shoot count for **Area 2 - 2t/ha**	483	Average shoot count for **Area 2 - 1t/ha**	546
Average shoot count for **Area 1 - 2t/ha**	444	Average shoot count for **Area 1 - 5t/ha**	425

Yield data-

HCPSL staff captured drone footage of the site prior to harvest. The drone footage clearly highlighted cane yield differences between the industry common practice and the variable rate practice. This footage showed that the variable rate practices had a positive cane yield outcome when compared to the industry common practice.

Below (on left) is close up image of the trial area (the red line splits the treatments in the image on the left) and you can visually see the difference in the treatment areas for the area highlighted in the variable rate map. This trend is always not so clear for all parts of the field.

It was disappointing that cane harvest data could not be collected from this site, but it was beyond the control of the technical service provider; however, the grower (Walter) was very satisfied upon reviewing the drone imaginary that the treatments had a positive impact on cane yield.

Trial 2 results:

The NDVI image (below) of the cowpea cover crop indicates very little crop yield variation after soil amendment applications prior to planting when compared to the cane NDVI image and zonal maps. Further crop monitoring will occur after the cane crop is established in 2021; the findings will be reported in subsequent reports.

The images below are those captured for trial 2 to date.

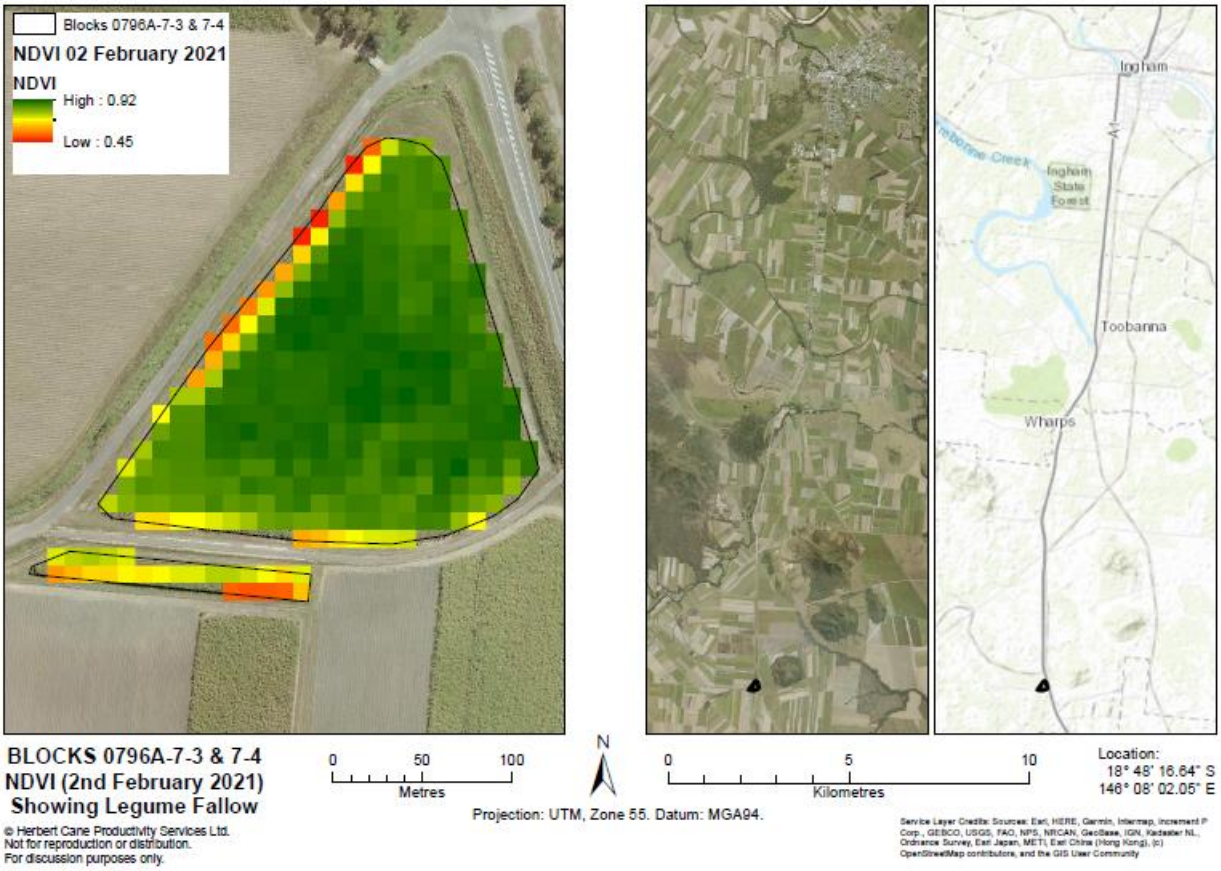
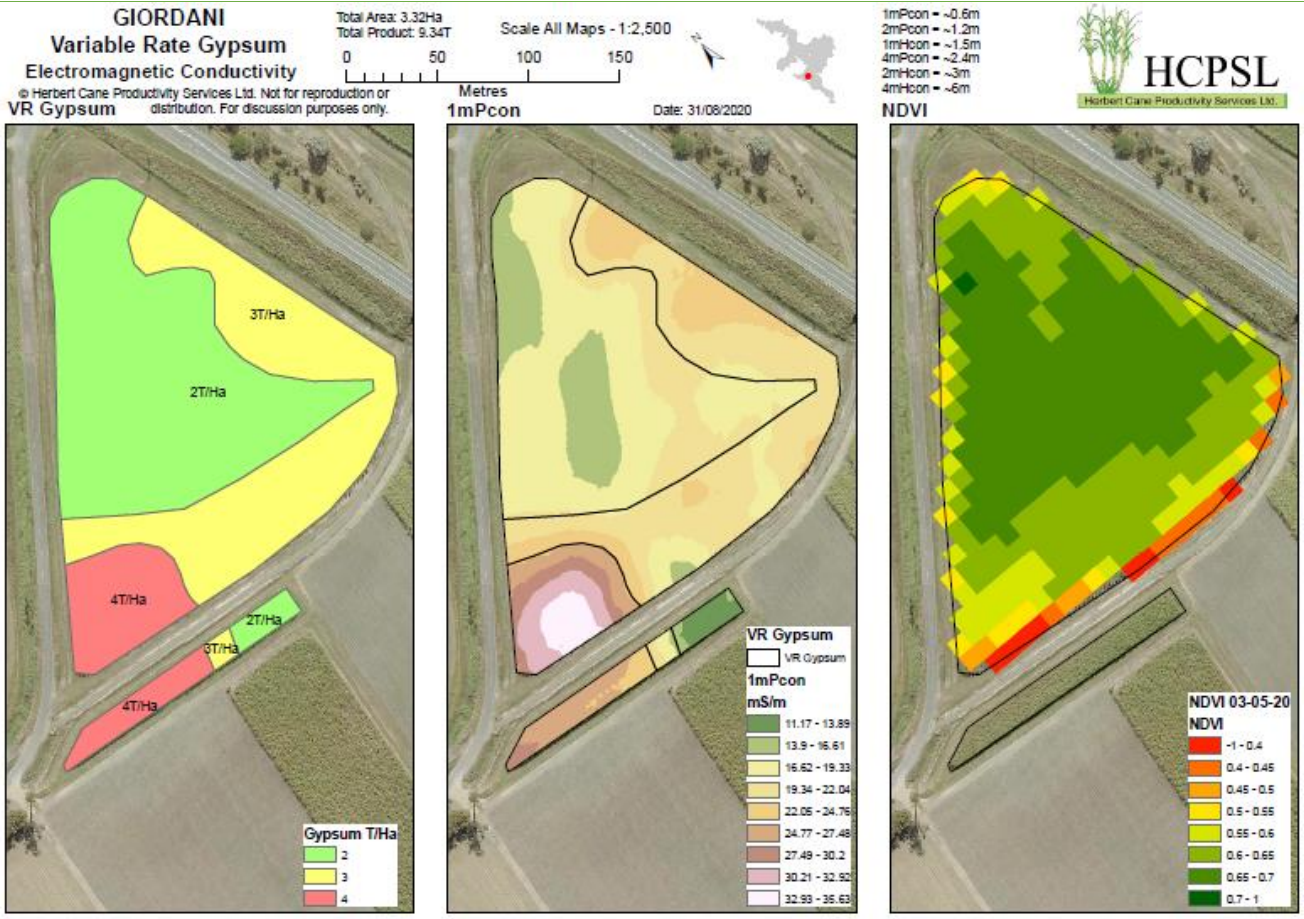


Image left- NDVI image taken of trial 2.
Map on right- Location map of trial 2.



Above left- variable rate map for trial 2
Above centre- zonal map for trial 2
Above right- NDVI map for May 2019 for the block while it was in cane for trial 2.

Conclusions and comments

The trials undertaken on Walter's farm have proven that variable rate applications of soil amendments like gypsum are achievable through the technology available. The trials have clearly shown that there are significant benefits from using variable rate application methods compared to treating the whole of block to remediate sodic areas within a block.

The benefits realised through the trials:

1. It is anticipated that improvements in crop germination and establishment found in trial 1 is positive and it is anticipated that this factor alone will greatly assist in achieving improved cane yields and subsequent ratoons.
2. Strategic targeting of high ESP areas within a field will remediate problematic areas better than the traditional industry approach of treating the whole field with 1 application rate of a soil amendment. It is also anticipated that variable rate applications will ensure "better boom for your buck" financially in the long term for a grower.
3. There are opportunities for improved crop growth through strategically targeted amendment applications as highlighted in the trials.
4. It is hoped that the increases in crop growth will lead to improved NUE and water quality, however this needs further investigation.
5. EM data and other geo spatial data like cane yield maps and NDVI imagery should be utilised together to develop the variable application maps.

The photo above is of Terry Low (Trimble technical officer) calibrating and observing the variable rate applicator in use.

Getting the variable rate technology correctly calibrated and importation of the variable rate map into GPS systems proved to be more challenging than first anticipated by Walter (the grower) and the project support team (HCPSL and Trimble staff), but it was achieved.

Walter has now decided that the results of trial 1 and 2 supports wide scale adoption across his whole farm. Walter has reported the trial results at various industry forums and a number of Herbert growers have or in the process of adopting similar approaches to better manage sodic soils.

Advantages of this Practice Change:

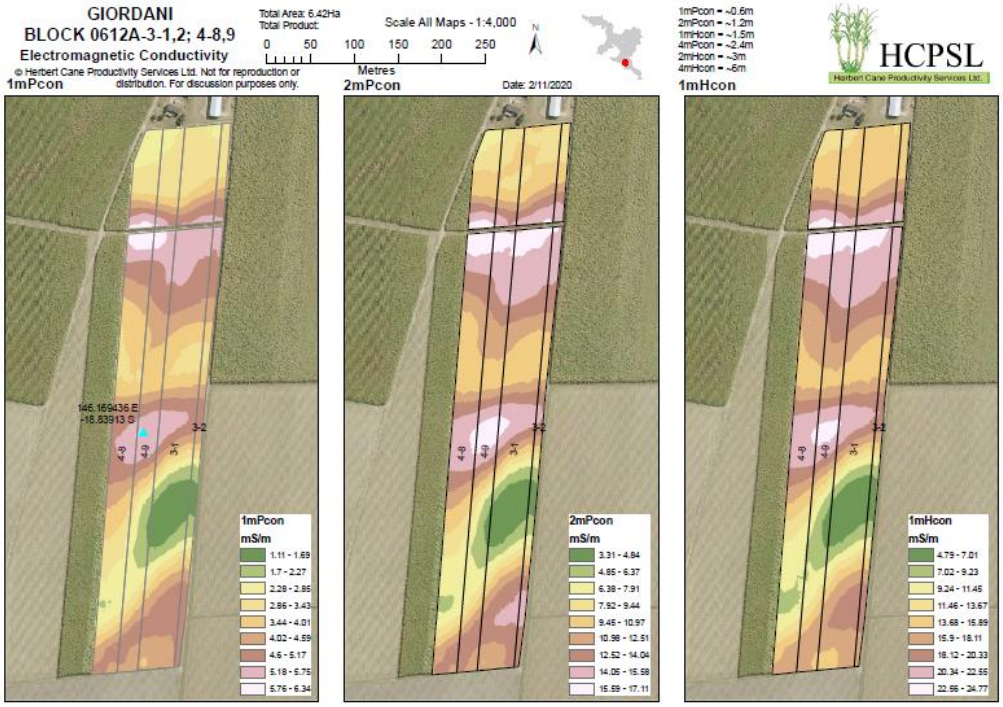
Economic- improved return on investment from the utilisation of soil amendments and monetary returns from the crop grown.
Soil health benefits- improved soil structure.
Nutrient benefits- improved nutrient utilisation of nutrients applied.
Water quality benefits- possible water quality improvements due to better crop utilisation of nutrients applied.

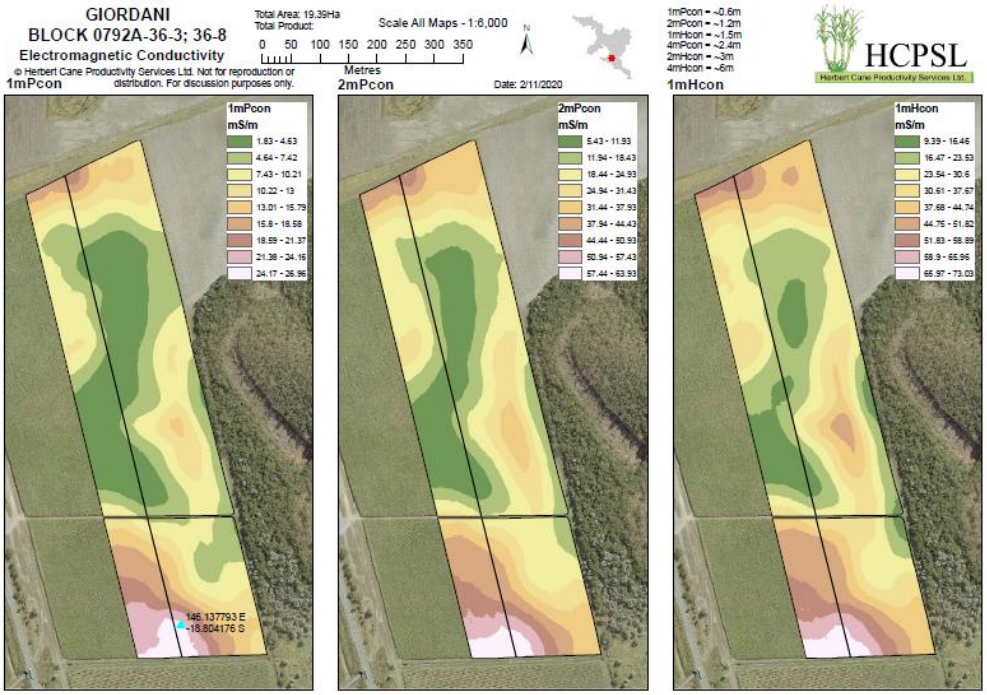
Disadvantages of this Practice Change:
Observations so far would have to say that the higher rates of gypsum have a higher nut grass coverage. So, the nutgrass issue would need to be address and managed once high amount of gypsum have been applied. The return of nutgrass however indicates that the sodicity in those high gypsum patches has shifted to a lower value which has allowed the nut grass to take advantage of the situation. So, this is a positive sign.

Will you be using this practice in the future?
Yes. Walter has decided that the results of trial 1 and 2 support wide scale adoption across his whole farm. In late 2020 Walter requested HCPSL to EM map the following blocks of his farm where he proposes to apply variable rate soil amendments in 2021:

- Farm 612A blocks 3-1, 3-2, 4-8 and 4-9.
- Farm 792A blocks 36-3 and 36-8.

Proposed blocks to be treated in 2021 (outside of the project) are below:





% of farm you would be confident to use this practice:
All sodic fallow blocks on farm.

References:

Nelson, P. and Ham, G. (1998). Soil sodicity: its influence on cane yield in the Burdekin, Proc. Aust. Soc. Sugar Cane Technol., 20:248-250.

Markle, J. and Hughes, J. (2019). A two zone paddock with productivity influenced by elevated sodium levels. https/sugarresarch.com.au

Webster, K. and Wilcox, T. (1999). Maintaining Soil Fertility. BSES publication.